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Quarterly Update

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Summary of SEI Accomplishments: 3Q91

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This section provides

a summary of

accomplishments from

July–September 1991

The sixth **SEI Affiliates Symposium** was held in August and included more than 25 hours of presentations highlighting SEI programs, plans, and activities, particularly in the area of software process. The symposium was attended by 690 representatives from affiliate organizations.

The **Software Process Assessment Project** team developed an assessment tutorial entitled "Software Process Assessment: Impacts of the New CMM." This tutorial was presented at the 1991 SEI Affiliates Symposium.

The **Software Capability Evaluation Project** completed work on the beta-test version of the Assistant for Evaluation of Software Practices (AESOP) tool, and site testing of AESOP at the Naval Ocean Systems Center in San Diego was initiated.

The **Software Capability Maturity Model Project** developed two technical reports that were released at the 1991 Affiliates Symposium: *Capability Maturity Model for Software* and *Key Practices of the Capability Maturity Model*.

At the Affiliates Symposium, members of the **Software Process Measurement and Empirical Methods Projects** were asked to convene an ad hoc working group of senior technical representatives from industry to discuss costs and benefits of proposed appendices for a work breakdown structure for software within MIL-STD-881B.

The NASA program office has officially decided to expand the use of **Rate Monotonic Analysis**, which was originally isolated to the Data Management System, to the entire Space Station program, where applicable.

Rate monotonic technology has penetrated one part of the hardware world as a result of the **Rate Monotonic Analysis for Real-Time Systems** Project's work on the FutureBus+ standard, leading to additional publicity about the technology.

Distributed Systems project members completed the initial port of Durra to the real-time computing network testbed. This is part of the joint activities between the Real-Time Embedded Systems Testbed and the Distributed Systems Projects.

The **Domain Analysis Project** hosted a successful workshop to review the methods and results to date of our domain analysis. Participants represented several Army research and development organizations as well as contractors actively working in movement control.

Software Risk Management project members conducted a "Risk Taxonomy Workshop" at the Affiliates Symposium, which focused on obtaining feedback about the risk taxonomy used when conducting risk assessments. The project members successfully negotiated an agreement with their first strategic DoD partner.

The **Master of Software Engineering** program welcomed 21 students in the 1991 entering class; 16 are attending full-time and 5 part-time. The students represent major computer companies such as Hewlett-Packard, Digital Equipment Corp., as well as government, aerospace, and financial institutions.

The **Continuing Education Project** hosted a workshop on August 26, the day before the Affiliates Symposium. The majority of the 53 attendees were from industry, though there were 9 participants from government organizations and 2 from universities.

The **Computer Emergency Response Team Coordination Center** held the third annual Computer Security Incident Response Workshop in Washington, DC, on August 6-8, 1991. The first draft of a computer security tutorial, focused on Internet-connected UNIX systems, was presented at the workshop.

The SEI welcomed 5 new resident affiliates, one from each of these organizations: GTE Government Systems; Electronic Systems Division, U.S. Air Force; AT&T Bell Laboratories; Department of Defense; and Unisys. Currently there are 14 **resident affiliates** working at the SEI: 7 from industry and 7 from government agencies and the services.

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Software Process

The Software Process Program focuses on improving the process of software development. Projects within the program are assessing the actual practice of software engineering in the defense community, training organizations to gain management control over their software development processes, supporting the use of quantitative methods and measures as a basis for process improvement, and developing improved methods for software process management.

The Software Process Assessment (SPA) Project helps organizations improve their software development process by providing a structured framework for assessing their current practice. The objectives of an assessment are to determine the organization's software process maturity, identify key areas for improvement, and help the organization initiate those improvements.

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Software Process Assessment

The SPA Project provides assessment briefings, training, and coaching services. In addition, it supports a set of nine commercial assessment vendors. The project is currently focusing its efforts on assessments as components of comprehensive process improvement programs.

In the third quarter, SPA Project members continued to support the development of the Software Capability Maturity Model and its associated products, including assisting members of the Software Capability Maturity Model Project in producing two reports: *Capability Maturity Model for Software* (CMU/SEI-91-TR-24) and *Key Practices of the Capability Maturity Model* (CMU/SEI-91-TR-25).

The SPA team developed an assessment tutorial entitled "Software Process Assessment: Impacts of the New CMM." This tutorial was presented at the 1991 SEI Affiliates Symposium. Also, two project embers developed and presented a report on the state of the practice in the United States.

SPA project members provided SEI assessment coaching to a number of DoD, vendor, and commercial clients including: Air Force Logistics Command (Oklahoma City, Oklahoma and Sacramento, California), Army Material Command Missile Command (Huntsville, Alabama), Arthur D. Little, the Software Productivity Consortium, and Hewlett-Packard.

In addition to the Affiliate Symposium and assessment coaching activities, Mary Merrill has been representing the SPA Project by preparing the SPA Resource Plan for the Corporate Information Management (CIM) TO&P (technical objectives and plans), and Jeff Perdue has been spearheading the planning for the upcoming vendor workshop.

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Software Capability
Evaluation

The Software Capability Evaluation (SCE) Project helps Department of Defense (DoD) acquisition organizations evaluate the capability of contractors to develop and maintain software competently. The project entails improving and implementing an evaluation method that examines the software process of contractors for use in software-intensive acquisitions.

Preparations for and attendance at the annual SEI Affiliates Symposium was the major event for SCE personnel throughout July and August. Project members worked with members of the Capability Maturity Model and SPA Projects in developing the *Capability Maturity Model for Software* (CMU/SEI-91-TR-24) technical report.

The project sponsored an SCE Experience Panel during the Affiliates Symposium. Participants delivered brief presentations describing their experiences in leading SCE teams during site visits. A question and answer session followed each presentation. The panel session proved to be an excellent forum for government, contractor, and SEI personnel to exchange information and thoughts about the SCE method.

During the quarter, several project members worked on the SCE team training revision design document and two of the five learning activity descriptions have been completed.

During July, work on the beta-test version of the Assistant for Evaluation of Software Practices (AESOP) tool was completed, and site testing of AESOP at the Naval Ocean Systems Center in San Diego was initiated. At the Affiliates Symposium in August, AESOP was demonstrated during the poster session.

Preparations for the SCE Team Training class, which will be held on October 1-3, 1991, took place throughout September. Six teams made up of 38 participants will be trained during this class, the largest to date. Because it is anticipated that this will be the typical class size in the future, efforts have been made to ensure that agendas and materials will be appropriate.

Also during September, papers were written and provided at the request of two SCE clients who needed clarification and guidance on SEI-recommended approaches to implementation of SCE.

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Software Capability
Maturity Model

The Software Capability Maturity Model (CMM) Project maintains an organizational model of software process maturity. This model will be continually updated with the state of the art as it evolves in software engineering, total quality management, and other relevant areas of improvement. It will elaborate software development practices that provide clear strategies for capability maturity growth and improvement.

The CMM project developed two technical reports that were released at the 1991 Affiliates Symposium: *Capability Maturity Model for Software* (CMU/SEI-91-TR-24) and *Key Practices of the Capability Maturity Model* (CMU/SEI-91-TR-25).

Capability Maturity Model for Software describes the Capability Maturity Model for Software and how it is used in process assessments and capability evaluations. *Key Practices of the Capability Maturity Model* lists the key software management and engineering practices that, in most cases, should be implemented at each maturity level. It is a guide for software professionals wishing to improve the maturity of

their organizations' software processes and serves as a reference for assessment and evaluation teams when conducting on-site investigations of an organization's software process. Both technical reports comprise the CMM notebook and were developed with extensive industry and government interaction over the past year.

Presentations at the Affiliates Symposium also addressed scoring issues and the release strategy for broad-scale dissemination of the CMM products. Using the key practices and questions from the preliminary version of the maturity questionnaire (CMU/SEI-87-TR-23), a prototype of an updated maturity questionnaire containing questions for maturity level 2 was developed and distributed to workshop attendees.

The Software Acquisition Process Development Project was renamed the Software Acquisition Evaluation Methods (SAEM) Project to more accurately reflect the direction of the project. The objective of the SAEM Project is to develop methods in assisting acquisition agents in evaluating the software component of a system at various phases in the acquisition process.

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Software Acquisition Evaluation Methods

The project's major focus this quarter has been on the development of a forthcoming technical report entitled *A Guide for Using Software Development Process Models in Support of Source Selection.*

Data collection continued at the Army Communication and Electronics Command using the Software Proposal Evaluation Practices Questionnaire. The data collection activity has been curtailed somewhat due to limited resources. Expectations are that it will pick up in January 1992.

One project member continued to support the Air Force Software Process Action Team. Meetings were attended in July, August, and September.

The Software Process Measurement Project advocates the use of measurement in managing software development. The project is formulating reliable measures of the software development process and products to guide and evaluate development. To expedite DoD and industry acceptance, the project convenes a steering committee and two working groups, and undertakes a best-practices study, all of which are devoted to encouraging organizations to use quantitative methods to improve their software processes.

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Software Process Measurement

During this quarter, the Software Metrics Definition Working Group—composed of the Quality, Size, and Effort/Schedule Subgroups—and the Software Acquisition Metrics Working Group held several working sessions to incorporate final revisions into the draft definitional documents. Project members and working group participants presented a summary of the definitional documents at the 1991 SEI Affiliates Symposium and distributed the following draft documents for external review:

- *Software Project Effort and Schedule Measurement*

- *Measuring Software Quality Using a Problem Management System*

- *Software Size Measurement, with Applications to Source Statement Counting*

The session concluded with a presentation on the technical report *Measurement in Practice* (CMU/SEI-91-TR-16), which was released at the 1991 SEI Affiliates Symposium.

Project members continued working collaboratively with Naval Air Development Center (NADC) personnel. Three site visits were conducted, each providing assistance to the NADC measurement working group in assembling the charter and the measurement implementation plan.

The project team hosted a meeting with the Measurement Steering Committee on September 26-27. This meeting was devoted to discussing future directions for the SEI measurement work. Project members have initiated a task that will integrate software measures with the CMM. The approach will entail mapping measures to existing key practice areas of the CMM, recommending use of specific measures, and providing guidance on use of the recommended measures.

In August, several project members made presentations on SEI measurement activities, software size measurement-source statement counting, and integrating software measures with the Capability Maturity Model at the Third Annual Software Quality Workshop, which was co-sponsored by Rochester Institute of Technology and Data & Analysis Center for Software.

Two project members, Anita Carleton and James Rozum, were invited participants at the Computer Software Management (CSM) Subgroup of the Joint Logistics Commanders Joint Policy Coordinating Group on Computer Resources Management meetings, which were held in Washington D.C. and San Diego. Project members also provided review comments on the San Antonio Software Workshop Reports to the CSM Subgroup.

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Software Process Definition

The objectives of the Software Process Definition Project are to establish the use of defined processes for the management and development of software as standard software engineering practice and to advance the capabilities required to define the software process within an organization. A "defined process" means that a process is documented, supported by training, and practiced, and that the practice, training, and documentation are generally found to be equivalent.

The project is supporting process development efforts at Standard Systems Center (SSC), Gunter Air Force Base. The project is also exploring advanced applications of process through the Software Technology for Adaptable, Reliable Systems (STARS) program.

During this quarter, the project held a three-day workshop at SSC entitled "Defining the Software Process – Getting Started." The workshop covered basic principles of process management, process improvement, process definition, and the descriptive modeling process. The workshop also included group exercises that allowed the participants to apply what they learned.

Project members completed product planning for a second workshop on process definition. This workshop will cover those activities required to initiate and prepare a working group charter and tactical plan.

The project provided on-site engineering support to SSC process improvement working groups in support of the development of working group products including:

- Software Configuration Management Working Group tactical plan and descriptive process model of current software configuration management process.
- Management Oversight Working Group Charter tactical plan.
- Project Management Working Group descriptive process model of current project management practice.

Project members also delivered a joint SSC/SEI presentation for the 1991 SEI Affiliates Symposium entitled "Software Process Definition: Principles to Practice." In addition, project members prepared and conducted a second on-site review of the SSC TO&P and project support plan for the coming fiscal year.

During this quarter, the project continued to provide support for the STARS program. Project members served on the STARS Process Joint Activities Group as Federally Funded Research and Development Center facilitators. In this capacity, project members participated in the development of strategies, concepts, and plans that will guide and direct the process component of the STARS effort. Project members also participated in the planning and development of an operational concept document for the process component of the STARS effort. The *Process Operational Concept Document* contains the technical foundation and descriptions of the operational capabilities proposed for the STARS environment.

Project members also participated in the development and delivery of the STARS Distinguished Reviewers briefing and gave a presentation on STARS process activities in the quarterly program management review. Project members also represented STARS at a meeting of the Defense Analysis Research Projects Agency (DARPA) Process Steering Group.

As participants in the development of STARS technology, project members developed a three-day workshop to be held in October. The workshop will reconvene an advisory group of leading professionals from industry and academia. The purpose of the workshop is to develop usage scenarios, operational concepts, and architectural concepts for a process library to support STARS. The workshop participants will also develop and prioritize a list of component types and component instances for the library. This task will lead to the development of a repository of reusable process assets that will support the STARS environment. This task will be accomplished in conjunction with STARS prime contractors.

Evaluation of Process Modeling Improvements
(CMU/SEI-91-TR-5)

Measurement in Practice
(CMU/SEI-91-TR-16)

Capability Maturity Model for Software
(CMU/SEI-91-TR-24)

Key Practices of the Capability Maturity Model
(CMU/SEI-91-TR-25)

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Software Process Reports

July–September 1991

Real-Time Systems

The goal of the Real-Time Distributed Systems Program is to improve the development of real-time distributed systems by integrating software engineering with systems engineering and reducing the risk associated with new technology.

The Rate Monotonic Analysis for Real-Time Systems (RMARTS) Project aims to ensure that rate monotonic analysis and scheduling algorithms become part of the standard practice for designing, building, troubleshooting, and maintaining real-time systems. Rate monotonic analysis (RMA) helps engineers to understand and predict the timing behavior of hard real-time systems to a degree not previously possible.

Goals of the project include increasing the use of rate monotonic theory on highly visible projects, obtaining support for the rate monotonic approach from national hardware and software standards, and promoting the development of training and consulting resources outside the SEI. These resources are intended to serve as the major means for widely transitioning RMA techniques to real-time system developers.

As part of the goal to increase the use of rate monotonic theory on highly visible projects, project members are working closely with the prime contractor for the Navy's BSY-2 system, a major distributed system, to ensure the successful use of RMA.

During this quarter, project members reviewed the RMA data collection sheets that have been developed for the BSY-2 program. These documents will serve as input for use by the National Aeronautics and Space Administration (NASA) Space Station and will be part of the Management Guidelines that the RMARTS Project will produce as part of its current project plan.

The group performing verification and validation on the Nuclear Partition of BSY-2 is looking at using RMA during validation.

Project members are working with the Navy's Next Generation Computer Resources (NGCR) Program to encourage the development of a local area network that adequately supports rate monotonic principles. Project members delivered an Ada binding to the SAFENET Lightweight Application Service definition. The target implementation is the Xpress Transport Protocol developed by Protocol Engines Inc. Project members continue to work on system end-to-end scheduling issues and have continued to examine the IEEE 802.6 network standard for its applicability to the real-time domain.

The NASA program office has officially decided to expand the use of RMA, which was originally isolated to the Data Management System, to the entire Space Station program, where applicable. Project members are working with NASA and NASA's Software Architecture Office to establish the process for the use of RMA for the space station's real-time software development.

NASA Langley inquired about training in RMA. A two-day class is being scheduled for January 1992. The intention is to help introduce outside training organizations to the SEI approach to training in RMA as well as to meet NASA Langley needs. It appears that at least one project at NASA Langley is already using RMA, based on available written materials.

General Dynamics plans to go forward in applying RMA during development to analyze the schedulability of their system.

Project members met with several representatives from Magnavox. Magnavox recently applied RMA to an existing system, and RMARTS project members reviewed a Magnavox paper that discussed this application. The paper provided a detailed analysis of their system and could provide a basis for case studies and for a handbook. Further collaboration is expected and being planned.

Project members were contacted by the Army Ballistic Missile Command, which expressed interest in having a project member work with them on a three-week study.

Nanotek Inc., a chip manufacturer, has sent us a "Preliminary Data Sheet" for a FutureBus+ implementation of the MIPS R3000 processor. FutureBus+ is the backplane standard influenced by the RMARTS Project to support rate monotonic scheduling. The data sheet says, "A total of 256 priority levels can be utilized for implementation of rate monotonic scheduling algorithms." Later in the data sheet, a section entitled "Limited Priority Inversion" states, "Profile F compatible systems may be designed which bound priority inversion to 100µs. Priority inversion is the time during which a module is waiting to have a bus request serviced while a lower priority module has control over the bus." In short, rate monotonic technology has penetrated one part of the hardware world as a result of the project's work on the FutureBus+ standard, leading to additional publicity about the technology. More important, manufacturers are beginning to tell the public how their approach limits priority inversion, thus drawing additional attention to the problem.

At a design review for a radar warning receiver being developed by Hughes Aircraft, the lead designer justified design decisions by appealing to rate monotonic analysis. The lead designer previously attended the TRI-Ada 90 tutorial and had participated in several meetings with project personnel prior to attending the tutorial.

Wind River Systems, the developers of a real-time executive system called VXWorks, is interested in the project's work on Usage/Performance Specifications and in supporting rate monotonic algorithms.

A paper, "Fixed Priority Scheduling of Periodic Tasks with Varying Execution Priorities," which is co-authored by RMARTS project members, has been accepted for presentation at the IEEE Real-Time Systems Symposium in December 1991.

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eal-Time Embedded ystems Testbed

The Real-Time Embedded Systems Testbed (REST) Project is collecting, classifying, generating, and disseminating information about Ada performance issues in hard real-time embedded systems.

Building real-time systems, particularly embedded and distributed real-time systems, is currently a craft rather than a structured, methodical endeavor. Tools, including the Ada programming language and the accompanying Ada runtime support facilities, are only beginning to fulfill their promise for raising the level of abstraction for

real-time programming. Use of such tools is still perceived as entailing a high degree of risk. One of the problems addressed by REST is the identification and the reduction of such risks.

At this time, the government does not routinely assess the quality of Ada compilation systems. Both Ada users and vendors need help to improve the quality of such systems. The identification, development, and distribution of techniques and tools to help improve Ada implementations is another problem addressed by REST.

This quarter, the project continued to refine the detailed design of the Hard Real-Time (Hartstone) Benchmark Suite by performing experiments toward the implementation of the Periodic Non-Harmonic Benchmark, the next program in the series. A transition approach and plan were also sketched and will be refined in the last quarter.

In support of BSY-2, the project is investigating the performance impact of Ada style using Ada Compiler Evaluation Capability (ACEC), Ada Evaluation System (AES), Performance Issues Working Group, and Hartstone benchmarks results collected in the previous quarter. Project members continued to participate in monthly meetings with General Electric and the compiler vendor, Verdix, to continue improving the compilation system and the performance of the BSY-2 software. Work intensified on a document critiquing the BSY-2 Ada style guide from a performance standpoint.

Since a memorandum of understanding has been signed between the U.S. and the U.K. to merge the U.S. ACEC and the British AES suites of benchmarks, REST has proposed and is preparing a workshop to study the technical issues involved.

The project produced the proceedings of the MIL-STD-1750A and Ada workshop organized at JPL in June.

In conjunction with the RMARTS Project, REST project members ported the Ada code of a prototype sporadic server to the testbed. A system was also procured to perform measurements on the Alsys/Lynx-OS implementation of the same algorithms. This work is of immediate applicability to the design of the Data Management System, the on-board software for the space station freedom program.

With the Distributed Systems (DS) Project, REST installed the Durra software on the Real-Time Communication Network hardware, on loan from IBM.

In cooperation with the DS and RMARTS Projects, REST project members defined and proposed a joint project for the software development studio of the Master of Software Engineering program. Durra forms the basis of a toolset designed to experiment with schedulability analysis and automatic benchmark generation.

The Distributed Systems Project (formerly Software for Heterogeneous Machines) is developing tools and a methodology for building distributed, large-grained, concurrent applications to run on networks of heterogeneous machines. The project has developed Durra, a language for describing distributed applications as a set of task descriptions and port connections. The Durra compiler generates Ada program units

Distributed Systems

that link clusters of application tasks as executable programs. A library package provides application/location-independent communication facilities to the application tasks.

Project members completed and delivered the final report on the TO&P effort sponsored by the Institute for Simulation and Training (IST) of the University of Central Florida. IST and their sponsor (PM-TRADE) are interested in the development of interoperable networks of simulation and training devices. To prevent network congestion, these applications will require intelligent gateways to filter network traffic (e.g., broadcasting of vehicle position). In this effort, project members developed simple emulators for vehicles, local area networks, and intelligent gateways and used Durra to implement various network configurations.

Project members completed the initial port of Durra to the real-time computing network testbed. This is part of the joint activities between the REST and Distributed Systems Projects. Future activities for this year include performance evaluation, fine-tuning, and using Durra to configure and build distributed benchmarks. Plans for joint activities during 1992 include automatic generation of benchmarks from formal specifications. (Generating benchmarks is a problem of interest to the project, and members are developing techniques for application prototyping and automatic program generation.)

Project members attended a meeting of the IEEE 1003.5 (Ada language binding to 1003.1), POSIX (portable operating system interface standard) System API (application program interface) Working Group in Santa Clara on July 8-12. The project will host the next meeting of the P1003.5 Ballot Review Committee starting on September 30 at the SEI. Dennis Doubleday was appointed Technical Reviewer of Chapter 7 of IEEE Draft Standard P1003.5 (Ada Binding to POSIX API).

Randall Lichota and Michael Gardner completed their assignments as resident industrial affiliates and returned to Hughes Aircraft and Westinghouse respectively. The two resident affiliate positions in the project are open.

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Systems Fault Tolerance

The Systems Fault Tolerance Project is in the feasibility stage, investigating the use of fault tolerance in the design and implementation of dependable or critical systems.

The Distinguished Lecture Series on Fault Tolerant Systems, which the SEI sponsors jointly with the Carnegie Mellon University Center for Dependable Systems, concluded this quarter with a presentation by Prof. Brian Randell on the Predictably Dependable Computer Systems Project, part of the ESPIRIT Program sponsored by the European Community. Copies of presentation slides from the Distinguished Lecture Series on Fault Tolerant Systems are available from the Systems Fault Tolerance Project. Planning is underway for the 1991-1992 lecture series. Among others, commitments to participate have been obtained from Tandem, Transarc Corp., Triconex, The University of Arizona, and Sequoia Systems.

Work is underway on the development of a classification scheme for faults and hazards. Since fault tolerant system requirements and performance are defined in terms of the faults to be tolerated, it is important to be able to describe these

faults without resorting to enumeration. We hope to be able to define fault and hazard classes with attributes that can be used to determine appropriate fault detection and recovery mechanisms.

Project members participated in a workshop on the dependability of telecommunications. Ironically, this workshop coincided with a major telephone service outage in the Pittsburgh area. A project member also participated in a workshop on System Evaluation and Assessment Technology sponsored by the Office of Naval Technology.

Since July 1, the project has been reviewing literature and planning its activities. The two initial goals of the project are to understand the relationship between a virtual reality and the user tasks necessary to navigate within one, and to build a mouse simulator for X windows out of low-cost head-mounted sighting devices and gloves.

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Virtual Reality

Rate Monotonic Analysis for Real-Time Systems (CMU/SEI-91-TR-6)

Issues in Real-Time Data Management (CMU/SEI-91-TR-17)

An Application-Level Implementation of the Sporadic Server (CMU/SEI-91-TR-26)

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Real-Time Systems Reports

July–September 1991

Software Engineering Techniques

The primary objective of the Software Engineering Techniques Program is to improve the practice of software engineering by improving individual and team productivity through the identification and transition to practice of emerging software technology. Promoting the appropriate use of this technology supports the SEI effort to transform software development from an ad-hoc, labor-intensive activity to a technology-supported engineering discipline.

To develop a fundamental understanding of structures for the software architecture level of design, the Software Architecture Design Principles Project is describing basic design elements used in the description, analysis, and development of software systems.

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Software Architecture Design Principles

A recent issue of *American Management Systems* devoted space to the project leader's material on an engineering discipline for software. The context was design quality.

A session is planned for the International Workshop on Software Specification and Design to take place in October. The introduction and assignment for session participants have been completed.

During this quarter, project members met with representatives from DARPA, Information Science Technology Office, Information Science and Technology Study Group, and the infrastructure project of the Office of Technology Assessment and the Computer Science and Telecommunications Board.

The Software Architectures Engineering (SAE) Project has been involved in the engineering of software in several critical DoD application areas for the last five years. The project goal is to use sets of identified patterns together with engineering design goals to provide guidelines for building the basic elements of software structure (models). The project is currently focusing on three aspects of this technology: the generalization of software architecture by providing templated structural elements and connection rules that invest the implemented software with the desired product qualities; the naturalization of the models so that real-world components have corresponding software analogs; and the application of tools and notations to software development based on generalized structures.

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Software Architectures Engineering

The SAE Project provides DoD program offices with improvements to the practice of software engineering by assisting in the creation and adoption of model-based technology. The project accomplishes these improvements by helping clients to abstract the desirable software architecture characteristics for particular classes of applications and to use them to create reusable patterns of software structures

specific to an application. Project members refine and mature the new models by transitioning them to other projects, which allows additional sources of reflection on their use.

The SAE Project has completed the first phase of work with the Air Force Electronic Combat Office (AFECO). This phase of the project is being done in conjunction with the Tri-Service CROSSBOW-S organization. Project members are converting the AFECO report, delivered in the first quarter of 1991, into an SEI technical report.

Project members continued working with the Tri-Service CROSSBOW-S organization on the Joint Modeling and Simulation System (J-MASS). The J-MASS project is developing a standard tool for development and operation of high-fidelity electronic combat simulations. J-MASS relies on the SAE Project's model-based software development concepts and the object-connection-update architectural model. SAE project members are participating as members of the J-MASS design team.

SAE Project members have also begun working with the Defense Modeling and Simulation Office (DMSO). During the first phase of work with the DMSO, project members will be outlining critical simulation issues in a report to be delivered by the end of 1991.

Project members are working with members of the DSSA Project. The research is funding several industrial/academic teams to focus on software architecture development in DoD-critical domains. The SAE Project will provide technical support to the program. SAE is also actively seeking a partner to participate in research under the program in the CIM application area.

Finally, SAE is continuing to work with the Naval Coastal Systems Center (NCSC) on the AN/SSQ-94 Combat System Integrated Training Equipment Program. SAE project members hosted and participated in the AN/SSQ-94 Architecture Working Group meetings on June 17-18 and August 26 at the SEI. The design decisions resulting from these meetings have been captured in an internal document "Minutes of the AN/SSQ-94 Architecture Working Group." The goal of the group and the document is to specify the architecture and models to be used for the application models, the executive, the environmental systems, the training coordinator station, and the application design.

The NCSC resident affiliate finished his full-time commitment with the project and began participation in the SEI Master of Software Engineering (MSE) Program.

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**Software Development
Environments**

The Software Development Environments (SDE) Project focuses on environment support for software configuration management (SCM). In particular, the project has been assessing commercial advances in SCM concepts and functionality and is investigating issues of integration between SCM, development tools, and environments.

Configuration management capabilities can be found in SCM tools, computer-aided software engineering (CASE) tools, and environment frameworks, each implementing its own variant of some of the concepts. This variety leads to the need to integrate

tools with different SCM capabilities into a software development environment, and the desire for a unified SCM model that can be adapted to different processes. As a result, the project is now focusing on the following activities:

- Investigating the interoperability of configuration management (CM) concepts by using the framework for relating SCM concepts found in actual SCM systems, including four conceptual models developed earlier.

- Providing an understanding of SCM as a key component of an SDE infrastructure by identifying its place in an integrated environment architecture.

- Addressing issues of integration between tools and SCM capabilities in environment frameworks with diverse SCM concepts by investigating emerging environment integration technologies.

- Exploring the feasibility of a unified SCM model integrating the spectrum of CM concepts into a coherent semantic model.

- Investigating the use of process modeling techniques and process enactment mechanisms in support of process adaptation of CM services.

This quarter, project members completed an article for the 1991 SEI Annual Technical Review entitled "Toward Integrated and Adaptable Configuration Management Services."

In collaboration with the CASE Project, two presentations were given in a series of four at a sponsor site: "The What and How of CASE Integration" and "Issues of Integrating CASE Tools with Configuration Management." Project members also participated in the third meeting of the Navy NGCR Project Support Environment Standards Working Group (PSEWG) effort. This Navy effort identifies and selects commercial standards in the environments area for use by the services. Project members continue to take the technical lead on a project support environment services reference model, which takes into account the ECMA/NIST (European Computer Manufacturer's Association/National Institutes of Standards and Technology) environment framework reference model. A revised draft of a services reference model white paper was made available to the reference model subgroup as input to a PSESWG reference model report.

Domain Analysis

The Domain Analysis Project is currently analyzing the Army movement control domain to discover and exploit commonality. The project is using the Feature-Oriented Domain Analysis (FODA) method, developed by the project in 1990, to perform this analysis. The analysis provides a model of applications within the domain that can be used for understanding the design of those applications and to support the development of new movement control software. The analysis will also serve as a means of improving the FODA method.

During this quarter, the project hosted a successful workshop to review the methods and results to date of our domain analysis. Participants represented several Army research and development organizations as well as contractors actively working in movement control. The organizations represented include:

Army	Contractors
Transportation School	Magnavox
Artillery School	Carnegie Group Inc.
Combined Arms Combat Support Command	Martin-Marietta
Waterways Experiment Station	COMARCO/IBS
Logistics Management Institute	
Human Engineering Lab	
Communication Electronics Command	

Questionnaires were distributed at the workshop and the comments received were favorable. The project is planning a follow-up meeting that will take place in approximately six months.

Project members have performed an analysis of the "001" tool from Hamilton Technologies Incorporated. The tool is being used to document the domain model and to validate a selection of features to support system development. The tool has been used to generate prototype software and, as the final stage of our current analysis, will be used to produce a sample system entitled MOVECON. The 001 tool and its products will be demonstrated to Army customers in November.

Lt. Cathy Lin from Electronic Systems Division has joined the project as a resident affiliate. Lieutenant Lin will be installing a domain modeling and repository tool named CARDS (Central Archive for Reusable Defense Software) on our system. As her first task, she will rehost our Army models on CARDS to evaluate the effectiveness of that tool. We will also incorporate aspects of the window manager domain model into a model of command centers.

During the quarter, project members attended several external meetings. Two members attended a one-day meeting sponsored by the National Security Agency on object-oriented development. They presented an overview of the domain analysis method and our use of the 001 tool. The project leader gave a project presentation at Lawrence Livermore Labs on August 12. Lawrence Livermore Labs has several areas of activity that are related to project work. A follow-up meeting is being scheduled to determine possibilities for interaction.

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Domain-Specific Software Architectures

The Domain-Specific Software Architectures (DSSA) Project champions the use of structural models, and the maturation of a structural modeling technology base that embraces all aspects of software development using structural models.

During this quarter, project members continued transition of the Special Operations Forces Aircrew Training System (SOF-ATS) to structural modeling. The program's Preliminary Design Review (PDR) proved to be the showcase for structural modeling

that it was intended to be. The PDR was attended by representatives of DoD commands and program offices. Attendees were impressed by the power of structural modeling.

Also during this quarter, the Aeronautical Systems Division, Deputy for Simulators (ASD/YW)-Industry TQ Steering Group briefed industry chief engineers on the application of structural modeling to simulators. The briefing featured speakers from both ASD and its contractors, all relating experiences with structural modeling. The briefings reflected both the favorable impressions about structural modeling, and the sense that structural modeling is maturing. ASD/YW reconfirmed its commitment to involve the SEI in the creation of a handbook or guide to disseminate lessons learned from the extensive use of structural modeling.

The SOF-ATS has also provided opportunities to extend the applicability of structural modeling to non-real-time systems, including the instructor operator station and the database generation systems, and to atypical real-time systems, such as threat simulation and radar image simulation. DSSA has worked with ASD/ENET (Aeronautical Systems Division Engineering Support Training Devices) and the SOF-ATS contractors to extend structural modeling to those areas, and will include the results in the handbook or guide.

During this quarter, DSSA collaboration with the BSY-2 Basic Operator Station focused on documentation of a structural model and the use of specification forms to plan and execute specification and implementation of a model-based software system. Naval Sea Combat Systems Engineering Station (NSCSES) has done an excellent job creating the specification forms, defining specific procedures for filling out specification forms, and executing the mapping of information in the forms to the structural model software templates. DSSA will continue to support NSCSES efforts, and also will begin work on a change management report that will describe the impact of structural modeling on development practices.

The Requirements Engineering Project is investigating the methods, tools, and processes necessary for the capture, analysis, and validation of requirements for software-intensive systems. Based on the recommendations from the Requirements Engineering and Analysis Workshop hosted by the SEI in the preceding quarter, the project has developed a detailed plan that is currently under review for approval.

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Requirements Engineering

The project plan includes a strategy built around the vision of a requirements engineering handbook similar to handbooks available in other engineering disciplines. This handbook will evolve as a living document, and will promote the proliferation of processes and techniques for iterative analysis and validation of requirements throughout the development process.

Project members are presently developing survey reports in four focus areas: requirements engineering processes, requirements elicitation, prototyping techniques for validation, and formal methods for critical requirements analysis. It is anticipated that these survey reports will form the core of the first release of the envisioned requirements engineering handbook. The reports will also provide the foundation for planned efforts including the selection of existing technologies and the development of new technologies supporting a unified process and approach to requirements engineering.

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CASE Technology

The CASE (computer-aided software engineering) Technology Project focuses on improving the ability of SEI sponsors and affiliates to make informed decisions about tool adoption and to improve their practice in the use of CASE tools. It also provides information to tool vendors on current tool usage and gaps in current technology.

The project released a draft copy of the *Guide to CASE Adoption* for the purpose of getting comments from the field. This guide identifies the major issues that an organization needs to address in adopting CASE technology. It answers commonly asked questions and it provides pointers to available resources.

A briefing was given at the 1991 Affiliates Symposium on selected current work of the project, including the work on adoption issues and the case study of environment integration, which was done jointly with the Software Development Environments Project. This case study examined how different environments and tools have addressed the integration issue. It describes the current state of the practice and emerging trends. A technical report, *Case Studies in Environment Integration* (CMU/SEI-91-TR-13), which describes this work, will be released in the fourth quarter of 1991.

The project has begun a new effort in support of the Standard Systems Center at Gunter Air Force Base. This effort is getting "lessons learned" from previous government-sponsored efforts at building or acquiring environments or tools. It will provide input on realistic options for future government efforts.

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**Software Engineering
Techniques Reports**

July–September 1991

Configuration Management Models in Commercial Environments
(CMU/SEI-91-TR-7)

Special Projects

Staff members of the Transition Models Project will develop a set of methods for planning, implementing, and assessing transition activities; these methods will be useful for technology producers and consumers both inside and outside the SEI. Transition Models staff will also provide SEI staff with education and training on technology transition concepts and approaches.

Transition Models

Project members presented a tutorial on software technology transition to members of the SEI and representatives of Sematech, the U.S. Air Force Computer Resource Management Technology effort, and Hewlett Packard.

Priscilla Fowler hosted a technical interchange meeting with Bob Horenstein and Barb Bowers of Hewlett Packard to discuss approaches to intraorganizational technology transfer and process improvement. Members of the SEI Process and Risk Programs and a representative of Sematech also participated.

Priscilla Fowler attended a meeting of the DoD Software Technology Plan (SWTP) writing team July 24-25 at the Institute for Defense Analyses (IDA) to continue work on the transition section of the document. While there, she met with Cathy McDonald and Karen Gordon of IDA to discuss definitions of the transition mechanisms included in a table in a draft of the SWTP. These definitions will be used by IDA in a survey of government departments and their technology transition efforts.

Plans continue in the development of an agenda and other specifics for the Council of Consortia CEOs (Chief Executive Officers) Technology Transfer Workshop, to be held at the SEI in late November. These plans are being jointly executed by the SEI and the Electric Power Research Institute. Attendance will be limited to two or three representatives from each major U.S. consortia.

The Transition Models Project sponsored a poster session at the SEI Affiliates Symposium. Contact information was obtained from approximately 150 people, who received copies of tutorial notes from the project tutorial on Software Technology Transition. The contact information has been converted to a preliminary project mailing list of those interested in software engineering technology transition.

During the symposium, project members and Ken McNulty of the SEI Program Development Division met with Ted Ziehe and other attendees from Sematech, in anticipation of collaboration in the area of software engineering technology transition.

Project members will collaborate with the RMARTS Project to pilot technology transition for RMA. Further details on the nature of the pilot will be available after further analysis of RMA transition experience to date.

The Empirical Methods group supports technology development, assessment efforts, and SEI technology projects by providing market research methods and materials, conducting surveys, and evaluating events or validating products of SEI projects. In addition, the group conducts the National Software Capacity Study.

Empirical Methods

During this quarter, Empirical Methods staff and colleagues from the Carnegie Mellon School of Urban and Public Affairs collected data for two upcoming reports for the National Software Capacity Study: (1) estimates of PDSS (Post-Deployment Software Support) status for the DoD, and (2) international software production. Interim data suggest that previous DoD PDSS estimates were low and that significant amounts of software production are moving to 19 countries around the globe.

Initiatives are needed to consider the need for federal legislation and partnerships between government and industry to keep the U.S. leadership position in global software production. Consideration should be given to ways to improve coordination among key agencies (for example, the DoD, Department of Education, National Science Foundation, Office of Personnel Management, etc.) to plan and implement appropriate actions in addressing the supply problem and the risks of losing the software industry to offshore competition. An interim briefing summary is available from Capacity Study staff.

In conjunction with the Software Process Program, Empirical Methods staff designed the process maturity questionnaire prototype, which was presented at the 1991 SEI Affiliates Symposium. Empirical Methods staff members will assist in the development and pilot testing of the updated questionnaire and related materials during the balance of 1991 and 1992, leading to the release of improved products.

Project members assisted members of the Continuing Education Project and the U.S. Air Force Computer Resource Management Technology effort in developing a prototype of materials to use in conducting a training needs analysis. The set of questionnaires and guides intended to administer and analyze data about the software work being done by people and the confidence levels those people have in doing the work their jobs require provide one indicator of areas where training may be needed. The questionnaires and related materials will undergo pilot testing in two Air Force operational commands during the fall and winter of 1991. The prototype will then be evaluated for broader development.

Software Risk Management

The goal of the Software Risk Management Program is to improve the management of risks that arise in the development of software-intensive systems. In this context, "risk" refers to the uncertainty and impact associated with an event; "management" refers to the identification and resolution of the risk. Managing risk, therefore, entails identifying those things that can go wrong and assessing their likelihood and impact. A premise of the Risk Program is that confronting risk in a systematic way is fundamental to controlling the quality, cost, and schedule of software products.

The proposal for the three-day executive-level course on *Software Risk Management* was completed and approved by the SEI Education and Training Review Board. This course is a transition mechanism for the Risk Program, offered in the context of the Continuing Education Project's Executive Curriculum, and is a stand-alone, follow-up course to *Software: Profit Through Process Improvement*. There are two specific goals that students of the course should achieve:

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Technical Development

- Learn the fundamental concepts and techniques of software risk management.

- Develop an "action plan" for incorporating software risk management into their organization.

Project members completed a survey paper based on our interview and assessment experiences, entitled: *Software Development Risk Management: An SEI Appraisal.* The results are:

- Risk management as it is practiced today on software-intensive programs is largely ad hoc.

- Communication is key to effective risk management.

Project members continued developing risk identification mechanisms by producing draft training reports on each mechanism. Once the mechanisms have been fully tested with risk assessments, these drafts will be updated and converted into technical reports.

As part of the 1991 SEI Affiliates Symposium, project members conducted a Risk Taxonomy Workshop focused on obtaining feedback about the risk taxonomy used when conducting risk assessments. This information will supplement the risk information base and help to refine risk taxonomy.

Project members have initiated development activities aimed at understanding risk analysis and risk action planning. The end result will be additional insight and mechanisms to support implementation of the software risk management paradigm.

Additionally, project members have successfully negotiated an agreement with their first strategic DoD partner. The agreement potentially covers a span of three years. During this time, project members and the strategic partner will:

- Conduct government interviews to understand the current state of software risk management in program offices.

- Conduct risk assessments and profiles on selected programs with our strategic partner and their contractors.

- Develop mechanisms to more effectively communicate risk information between the government program office and their industry counterparts.

This quarter, project members continued to conduct interviews with industry to gather information on the current practice of risk management and risk communication. One additional industry interview was completed, and a follow-up meeting was held to gather feedback on the risk assessment process and to explore more effective means of risk communication.

Development of the risk profile concept and process was completed during this quarter. Risk profiles are another vehicle for identifying risks (similar to risk assessments) that emphasize risk communication and risk mitigation strategies. Project members are currently negotiating with a government sponsor for the first risk profile.

Project members are developing a pipeline of potential clients to ensure a continuous stream of risk assessment activity. Project members are currently coordinating risk assessment 2 and negotiating with 3 additional organizations for future risk assessments. In addition, project members are continuing to make executive-level contacts and briefings to further prime the pipeline. Project members continued to work on the SEI and National Security Industrial Association Software Risk Conference, which is scheduled for October. A total of 20 papers were selected for the conference, as well as the keynote address by USAF Brig. Gen. Kenneth Israel. Opening presentations will be given by Dr. Barry Bochm, DARPA, and Mr. Clyde Chittistei, SEI Risk Program Director.

Software Engineering Education Program

The primary objective of the Software Engineering Education Program is to increase the number of highly qualified software engineers by rapidly improving software engineering education throughout the education communities of academia, government, and industry. To accomplish this, the projects of the Education Program focus on accelerating the development of software engineering programs in academia and on enhancing opportunities for the continuing education of practitioners.

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Graduate Curriculum

The Graduate Curriculum Project is developing model curricula, promoting the growth of graduate software engineering programs in the academic community, and working to increase the amount of software engineering content in graduate computer science programs. The project produces educational materials, including the Academic Series, a set of videotaped graduate-level courses on software engineering.

The project completed three new products relating to software project courses during this quarter. *Models of Software Engineering Project Courses* (CMU/SEI-91-TR-10) uses data from the *Software Engineering Education Directory* (CMU/SEI-90-TR-4) and the authors' teaching experiences to assess the spectrum of software engineering project courses in the United States. Further details of how to teach such courses were captured in *A Software Engineering Project Course with a Real Client* (CMU/SEI-91-EM-4) and *Materials for Teaching a Project-Intensive Introduction to Software Engineering* (CMU/SEI-91-EM-6).

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Master of Software Engineering

In response to industry's growing demand for skilled software developers, Carnegie Mellon University (CMU) offers a 16-month master's degree program in software engineering. The program is a joint effort of the Carnegie Mellon School of Computer Science and the SEI. The core of the program is based on the SEI curriculum recommendations for MSE programs.

The MSE program welcomed 21 students in the 1991 entering class; 16 are attending full-time and 5 part-time. The students represent major computer companies such as Hewlett-Packard, Digital Equipment Corp., as well as government, aerospace, and financial institutions. Students also come from Austria, France, and Japan.

This group will be the first to use the recently revised curriculum, which has an increased emphasis on the Software Development Studio. The studio projects for this class include joint work with the CMU and University of Karlsruhe Architecture departments, the CMU Philosophy Department, the CMU Robotics Institute, and three SEI projects (Distributed Systems, Real-Time Embedded Systems Testbed, and Rate Monotonic Analysis for Real-Time Systems).

●●●●●●●●●●●●●● **Continuing Education**

The Continuing Education Project interacts with industry and government to increase the availability of high-quality educational opportunities for software practitioners and executives. The project produces the Continuing Education Series and the Technology Series. In the Continuing Education Series are video-based courses designed for clients' in-house education, and executive offerings designed for decision makers involved in improvement efforts. The Technology Series provides stand-alone presentations that promote awareness of emerging issues and leading-edge technologies.

Senior officers and other management and technical personnel at Scott Air Force Base attended a one-day version of *Software: Profit Through Process Improvement*. The SEI presented this intensive version of the two-day executive seminar on-site at Scott to 35 attendees. Topics included process assessment, risk management, software quality, and productivity. In hands-on activities, each participant began drafting executive action plans for improving their organization's software development process.

The three-day executive course, *Software Quality Improvement*, was given at the SEI in September. The 24 participants included executives from Air Force Military Personnel Center, Air Force Technology Integration Center, American Airlines, Defense Information Systems Agency, Grumman Melbourne, Lawrence Livermore, Martin Marietta, Naval Surface Warfare Center, Naval Ocean Systems Center, US Navy (Cruise Missile), USTRANSCOM, and Westinghouse Electric Corporation. In a format similar to other SEI executive courses, participants developed executive action plans for quality improvement and discussed quality issues.

Continuing Education staff members gave 2 presentations at the 1991 SEI Affiliates Symposium: "Continuing Education in Software Requirements Engineering," and "Good Software is Good Business: Crafting Seminars for Executives." Approximately 150 people attended the sessions.

The SEI Continuing Education Workshop was held on August 26, the day before the Affiliates Symposium. The majority of the 53 attendees were from industry, though there were 9 participants from government organizations and 2 from universities. The theme of the workshop was "Empowering Software Professionals Through Education." Presentations addressed the unique problems that arise in providing education for practicing software engineers about the principles of software engineering. Topics included facilitating adult learning, implementing the Kaizen approach, and enhancing instructional delivery of a course on specification of software systems.

●●●●●●●●●●●●● **Undergraduate Curriculum**

The Undergraduate Curriculum Project focuses on the long-term development of a highly qualified work force by addressing the needs of the majority of undergraduate computing students who do not pursue an advanced degree. The project promotes and accelerates the development of software engineering as an academic discipline and promotes the establishment of undergraduate software engineering degree programs in the academic community.

At the SEI 1991 Affiliates Symposium, project staff presented a model undergraduate curriculum in a talk entitled "In Search of the Next Generation of Software Engineers."

A similar presentation on the Bachelor of Science in Software Engineering was given at the Washington Ada Symposium and Summer SIGAda Meeting held in McLean, Virginia, in June. Participants in the session were primarily from the defense contractor community.

The project also published an annotated bibliography of software engineering textbooks in the June 1991 issue of *SIGCSE Bulletin*, a publication of the ACM Special Interest Group on Computer Science Education.

The project has advised DARPA on ways to increase the amount of software engineering content in undergraduate curriculum and to encourage the teaching of Ada in undergraduate courses. As a result, DARPA recently announced a curriculum development grant program, funded jointly by DARPA and the Ada Joint Program Office. A project member helped DARPA review the proposals for grants.

Models of Software Engineering Project Courses
(CMU/SEI-91-TR-10)

A Software Engineering Project Course with a Real Client
(CMU/SEI-91-EM-4)

Materials for Teaching a Project-Intensive Introduction to Software Engineering
(CMU/SEI-91-EM-6)

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**Software Engineering
Education Reports**

July–September 1991

DARPA/STARS

As Ada use becomes more common in software-dependent systems and as requirements grow, system developers will be faced with both the benefits and problems of adopting more disciplined and integrated approaches to software engineering. The goals of DARPA/STARS Support are to serve as a focal point and facilitator in removing technical and managerial impediments to the adoption of Ada; to support the STARS Program in technology development, integration, and transition efforts; and to support DARPA efforts to develop, evaluate, and disseminate new software engineering approaches derived from the development of software architectures characteristic of particular application areas.

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Binding of Ada and SQL

The Binding of Ada and SQL Project, initiated at the request of the Ada Joint Program Office, has investigated the problem of binding the Ada programming language with the Structured Query Language (SQL) database language. The solution to this problem was the specification of the SQL Ada Module Extension (SAME), an interface that permits an application program written in Ada to access and manipulate data controlled by a database management system (DBMS) using SQL.

The SEI technical report *Notes on Applications of the SQL Ada Module Description Language (SAMeDL)* (CMU/SEI-91-TR-12) was published this quarter. A copy was sent to the Ada Joint Program Office (AJPO) in fulfillment of a contract deliverable.

The SAMeDL was presented to a subworking group of the Common Operating Environment (COE) Technical Working Group. The COE is an initiative undertaken by the Navy, the Army, and the Marine Corps, with the subsequent addition of the Air Force, to create a common operating environment to promote "command, control, communications, computers, and intelligence (C4I) interoperability and efficient porting of C4I application software among different hardware environments."

The response of the SAMeDC SQL (Structured Query Language) Ada Module Extensions Design) to the Draft International SQL Standard (DIS 9075:100x) was forwarded to and accepted by the American National Standards Institute (ANSI) database standardization subcommittee (X3H2). A second response on issues not covered in the original document is being prepared by the committee.

In response to suggestions made by the ANSI database committee, X3H2, the *SAMeDL Reference Manual* has been modified to conform to International Standards Organization style guides and to Entry Level SQL as described in DIS 9075:199x.

A response to the X3H2 document, *The SAMeDL Ada-SQL Interface Approach*, will be prepared. An effort to resolve the X3H2 objections will be made. The vote by ISO Working Group 9 to advance SAMeDL to Draft International Standard status, originally planned for the October 1991 meeting, will be rescheduled for the Spring 1992 meeting.

Dissemination of SAMeDL information through workshops, conferences, panel sessions, and working groups will continue.

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DARPA/STARS
Reports

July–Septemuer 1991

CERT Coordination Center

The Computer Emergency Response Team Coordination Center (CERT/CC) supplements existing mechanisms by which informally organized experts address and prevent computer emergencies. The CERT/CC at the SEI supports two different communities: Internet users, and developers of technology that is available on the network, such as UNIX and networking software. The CERT/CC provides a dependable 24-hour point of contact for security issues and allows rapid communication during emergencies. It also raises constituents' awareness of security issues and assists individual organizations in improving the security of their systems. Finally, the CERT/CC maintains a highly secure repository of information for team members and cultivates close ties with researchers in the area of trusted systems to improve the security of existing systems.

Since its inception in 1988, the CERT/CC has responded to a continual stream of reported security incidents. These include reports of intrusions, worms, and viruses as well as reports of vulnerabilities and suggested fixes for problems. In handling these problems, the CERT/CC issues advisories to the Internet community to warn them of problems and inform them of preventive techniques. In cases where vulnerabilities exist, the CERT/CC works with software vendors and the technical community in analyzing and resolving the problems.

The third annual Computer Security Incident Response Workshop was held in Washington, DC, on August 6-8, 1991. Papers, invited presentations, and workshops covered the following topics: network intrusions, incident handling procedures and policies, legal and investigative issues, system vendor activities, ethical issues, vulnerabilities and malicious code, securing wide area networks, and CERT system operations.

The first draft of a computer security tutorial, focused on Internet-connected UNIX systems, was presented at the Computer Security Incident Response Workshop in August. The tutorial was well received and will be expanded to include material for system administrators and managers.

Guidelines for Secure Operation of the Internet, a document written by the Security Policy Working Group, is in final draft and will be submitted in October as an Informational RFC (request for comments). (Final Informational RFCs have been reviewed and approved, and are not open for further comment.)

The CERT/CC announced the creation of an archive service for clippings related to computer security. This archive will be a central repository for selected security-related USENET News and mailing list postings. The archive will not be

restricted to any one newsgroup or mailing list. The purpose of this archive is to provide security information without the unrelated discussions. It will also provide information from newsgroups not available to some sites. This archive is being maintained through the help of volunteers. Additional volunteer news clippers are needed. The clippings archive is available via anonymous ftp from the cert.sei.cmu.edu (192.88.209.5) system in the directory pub/clippings.

Members of the staff attended the Common Authentication Technology (CAT) Working Group. Currently, there are only two authentication mechanisms (Kerberos and SPX) that can be specified within the CAT. This group is involved in creating an generic interface that can be used by a number of protocols (for example, telnet) to provide authentication.

CERT participated in a meeting of the Trusted Systems Interoperability Group (TSIG) in Atlanta, which was held in parallel with an Internet Engineering Task Force (IETF) meeting. The TSIG is a group of approximately 70 members, most of whom are vendors, that meet to work out security solutions that will span multiple vendor products. They currently have several working groups and are trying to introduce standards work into the IETF mechanisms.

Affiliate Relations

The Affiliate Relations Function establishes and maintains SEI relationships with
industry, government, and academia, providing access to SEI information through
mailings, telephone contact, special meetings, and symposia. Affiliate Relations also
cooperates with the SEI Joint Program Office to negotiate for and place resident affiliates
at the SEI.

The sixth SEI Affiliates Symposium was held August 27-29 and included more than 25 hours of
presentations highlighting SEI programs, plans, and activities. During this Symposium, we em-
phasized our work in software process, taking advantage of developments in the capability ma-
turity model, the maturity questionnaire, and software measurement. The symposium was
attended by 690 representatives from affiliate organizations.

New industry affiliates from 12 organizations signed information exchange agree-
ments during this quarter: American Management Systems Inc.; Beckman
Instruments Inc.; Developmental Sciences Corporation; FileNet Corporation; Idaho
National Engineering Laboratory; JCS Systems; Juran Institute Inc.; NKF
Engineering Inc.; S & P Consultants; STATISTICA Inc.; Sierra Nevada
Corporation; and Westinghouse Savannah River Company.

New academic affiliates from three institutions also signed information exchange
agreements during the third quarter of 1991: Colorado Technical College; Purdue
University, School of Engineering & Technology at Indianapolis; and the University
of Texas at Arlington.

This quarter, the SEI welcomed 5 new resident affiliates, one from each of these
organizations: GTE Government Systems; Electronic Systems Division, U.S. Air
Force; AT&T Bell Laboratories; Department of Defense; and UNYSIS. As of
September 30, 14 resident affiliates were working at the SEI: 7 from industry
and 7 from government agencies and the services. In this quarter, 4 resident
affiliates concluded their technical project assignments at the SEI.

The next Visitors Day is scheduled to take place on November 13, 1991. This event
is held quarterly to accommodate the increasing number of requests for visits to the
SEI. Visitors must register in advance for Visitors Day; walk-ins are not accepted.
For additional information about Visitors Day, contact Affiliate Relations.

For More Information

To order an SEI publication, send a written request accompanied by a preaddressed mailing label to:

> Software Engineering Institute
> ATTN: Publications Requests
> Carnegie Mellon University
> Pittsburgh, PA 15213-3890

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**How to Order
SEI Publications**

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> Software Engineering Institute
> ATTN: Bridge Mailing List
> Carnegie Mellon University
> Pittsburgh, PA 15213-3890
> Internet: bridge-editor@sei.cmu.edu

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**How to Get the
SEI Magazine**

For information on opportunities for affiliation, contact:

> Software Engineering Institute
> ATTN: Janice Marchok
> Carnegie Mellon University
> Pittsburgh, PA 15213-3890
> (412) 268-6815
> Internet: jmm@sei.cmu.edu

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**How to Become
an SEI Affiliate**

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**How to Get
Additional Information**

List of Acronyms

ACEC	Ada Compiler Evaluation Capability
AES	Ada Evaluation System
ANSI	American National Standards Institute
API	Application Program Interface
ASD/YW	Aeronautical Systems Division, Deputy for Simulators
C4I	Command, Control, Communications, Computers, and Intelligence
CARDS	Central Archive for Reusable Defense Software
CASE	Computer-Aided Software Engineering
CAT	Common Authentication Technology
CERT/CC	Computer Emergency Response Team Coordination Center
CIM	Corporate Information Management
CM	Configuration Management
CMM	Capability Maturity Model
CMU	Carnegie Mellon University
COE	Common Operating Environment
CSM	Computer Software Management
DARPA	Defense Analysis Research Projects Agency
DMSO	Defense Modeling and Simulation Office
DoD	Department of Defense
DS	Distributed Systems
ECMA	European Computer Manufacturer's Association
ENET	Engineering Support Training Devices
FODA	Feature-Oriented Domain Analysis
IDA	Institute for Defense Analyses
IETF	Internet Engineering Task Force
ISC	International Standards Organization
IST	Institute for Simulation and Training
J-MASS	Joint Modeling and Simulation System
MSE	Master of Software Engineering
NADC	Naval Air Development Center
NASA	National Aeronautics and Space Administration
NCSC	Naval Coastal Systems Center
NGCR	Next Generation Computer Resources
NIST	National Institutes of Standards and Technology
NSCSES	Naval Sea Combat Systems Engineering Station
PDR	Preliminary Design Review
POSIX	Portable Operating System Interface Standard
PDSS	Post-Deployment Software Support
PSEWG	Project Support Environment Standards Working Group
RFC	Request for Comments
RMA	Rate Monotonic Analysis
RMARTS	Rate Monotonic Analysis for Real-Time Systems
SAE	Software Architectures Engineering
SAMeDC	SQL Ada Module Extensions Design
SAMeDL	SQL Ada Module Description Language
SCE	Software Capability Evaluation
SCM	Software Configuration Management
SDE	Software Development Environments
SOF-ATS	Special Operations Forces Aircrew Training System
SPA	Software Process Assessment
SQL	Structured Query Language
SSC	Standard Systems Center
STARS	Software Technology for Adaptable, Reliable Systems
SWTP	Software Technology Plan
TO&P	Technical objectives and plans
TSIG	Trusted Systems Interoperability Group
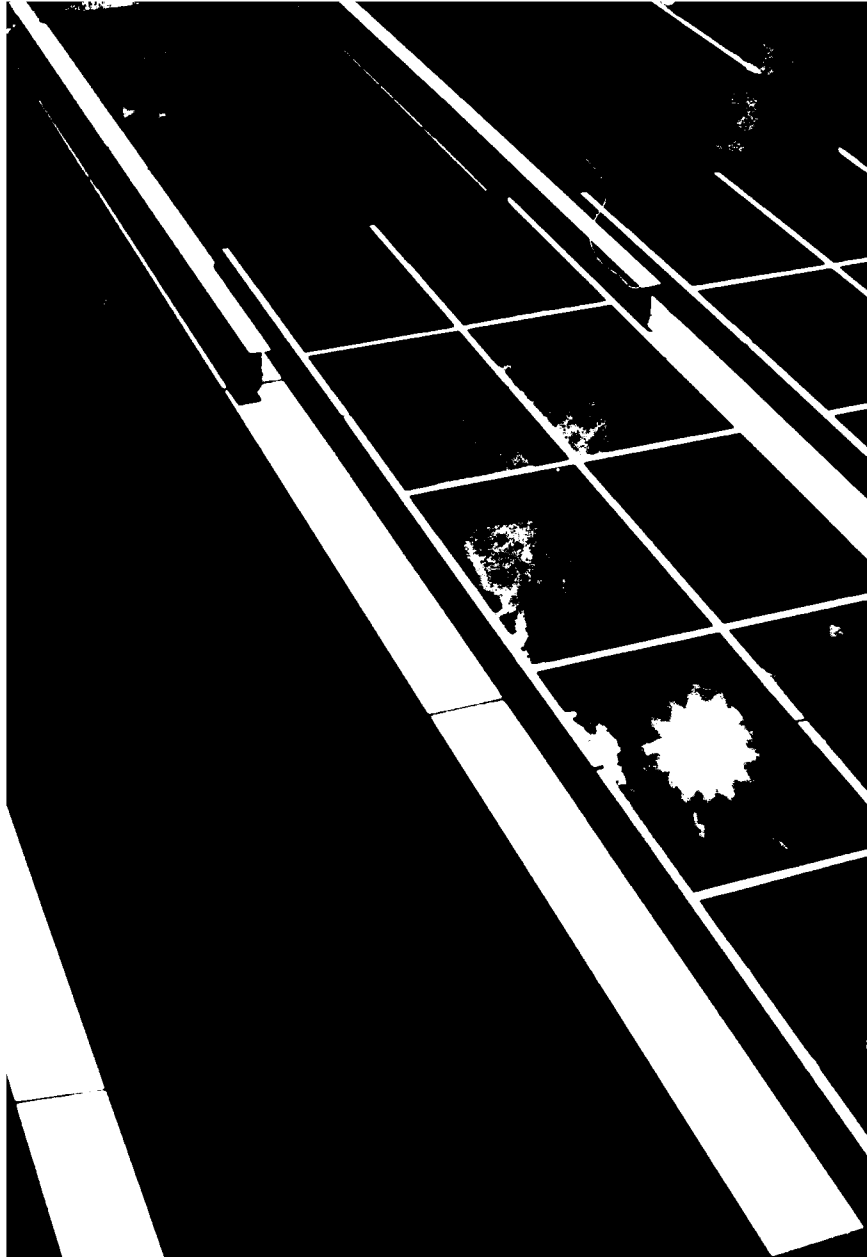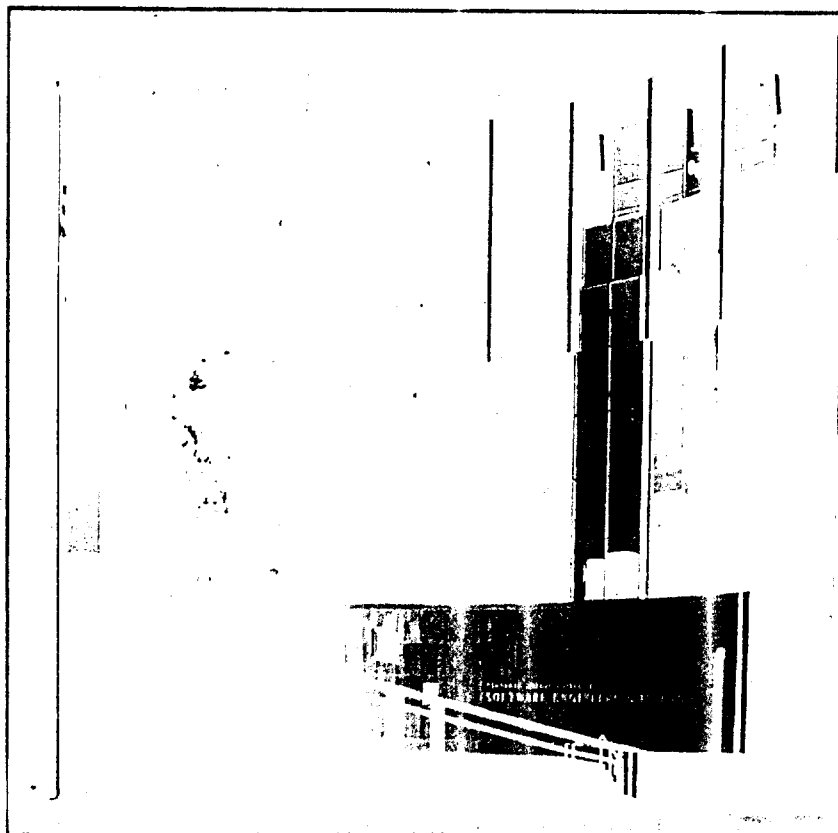
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